1F100

ER/WM&I DDT

000063949

Source/Driver (Name & Number from ISP, IAG milestone, Mgmt Action, Corres Control, etc)

Annette Primrose
Originator Name

Closure # (Outgoing Correspondence Control #, if applicable)

R S Luker
QA Approval

Due Date

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Document Classification Review Waiver Per Classification office

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Kaiser-Hill Director

Document Subject

KH00003NS1A

Results of the 1996 Pre-Remedial Investigation of the Mound Site - AMT-065-96

September 27, 1996

96-RM-ER-0179-KH

Discussion and/or Comments.

Attached are five copies of the Final Results of the 1996 Pre-Remedial Investigation of the Mound Site All of the edits you provided have been incorporated If you have any questions, please contact John Law at extension 4842, or Annette Primrose at extension 4385

ALP slm

cc
J E Law
A L Primrose
A M Tyson
RMRS Records

1/22

ADMIN RECORD

ER/WM & I DDT 7/95

BZ-A-000474

RF/RMRS-96-0055 UN

Results of the 1996 Pre-Remedial Investigation of the Mound Site

Rocky Mountain Remediation Services, L.L.C.

September 27, 1996

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Date

John J Rampe
Program Liaison Division
DOE, RFFO

SUBMITTAL OF FINAL RESULTS OF THE 1996 PRE-REMEDIAL INVESTIGATION OF THE MOUND SITE - AKS-XXX-96

Enclosed are two copies of the Final Results of the 1996 Pre-Remedial Investigation of the Mound Site

If you have any questions, please contact me at extension 9886

Thank you

Ann K Sieben
Title

ASK xxx

cc

L	A	Archuleta	-	RMRS	-	Bldg T893B
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A	L	Primrose	-	RMRS	-	Bldg T893A
G	H	Setlock	-	Kaiser-Hill	-	Bldg T130C
A	M	Tyson	-	RMRS	-	Bldg T893B

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FIGURES

TABLES

1.0 PURPOSE

The Mound Site Pre-Remedial Investigation was conducted in August and September of 1996 to better define the extent of volatile organic compound (VOC) contamination that was identified during previous investigations The purpose of this investigation was to support early removal actions by defining the areal extent of the VOC contamination at the Mound Site (IHSS 113) This report presents the data collected from the latest investigation which will be used to estimate volumes of soil requiring removal for treatment or disposal

2.0 INTRODUCTION

The Mound Site was used as a disposal site for approximately 1,405 drums from April 1954 to September 1958 Drums contained depleted uranium, beryllium, lathe coolant (about 70% hydraulic oil and 30% carbon tetrachloride) and tetrachloroethene (PCE) In 1970, 12 years after burial of the drums, the drums were removed along with radioactive soils which were identified using hand-held instruments Additional radioactive soils were identified and removed at later dates (DOE 1992) Figures 1 1 through 1 4 show the Mound Site before, during and after the placement and recovery of the drums

This area was extensively investigated as part of the Operable Unit 2 (OU 2) Phase II RFI/RI investigation Volatile organic compounds (VOCs) were identified in both subsurface soil, and in a groundwater contaminant plume which apparently migrates to the north from the Mound Site towards South Walnut Creek (DOE 1995a) A soil gas study in 1994 identified an area with elevated volatile organic readings at the northeast corner of the Mound Site The 1995 Trenches and Mound Site investigation (RMRS 1996a) collected additional subsurface soil samples in the contaminated area defined by the soil gas survey

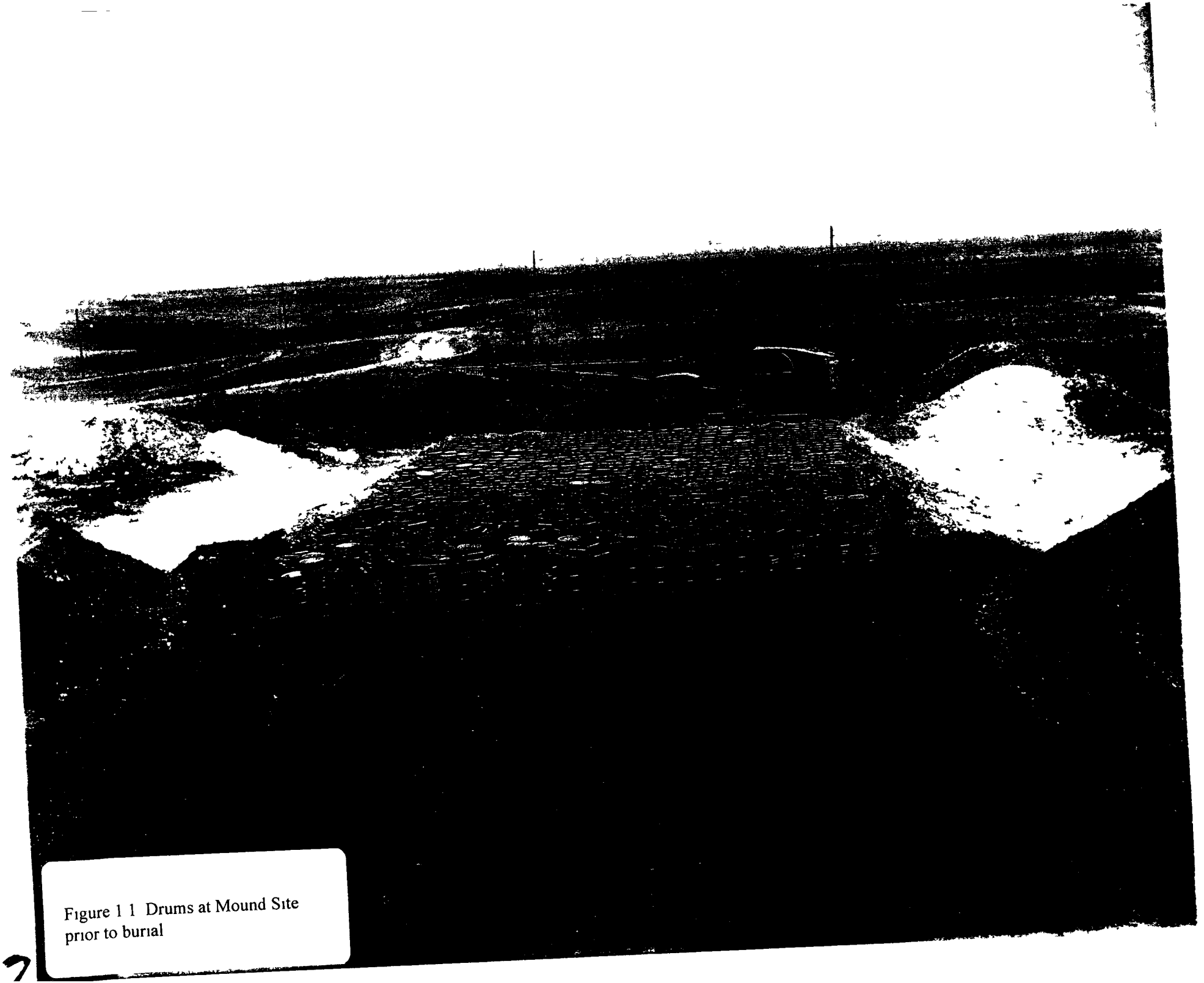


Figure 1 1 Drums at Mound Site prior to burial

Figure 1 2 Drums at Mound Site during burial

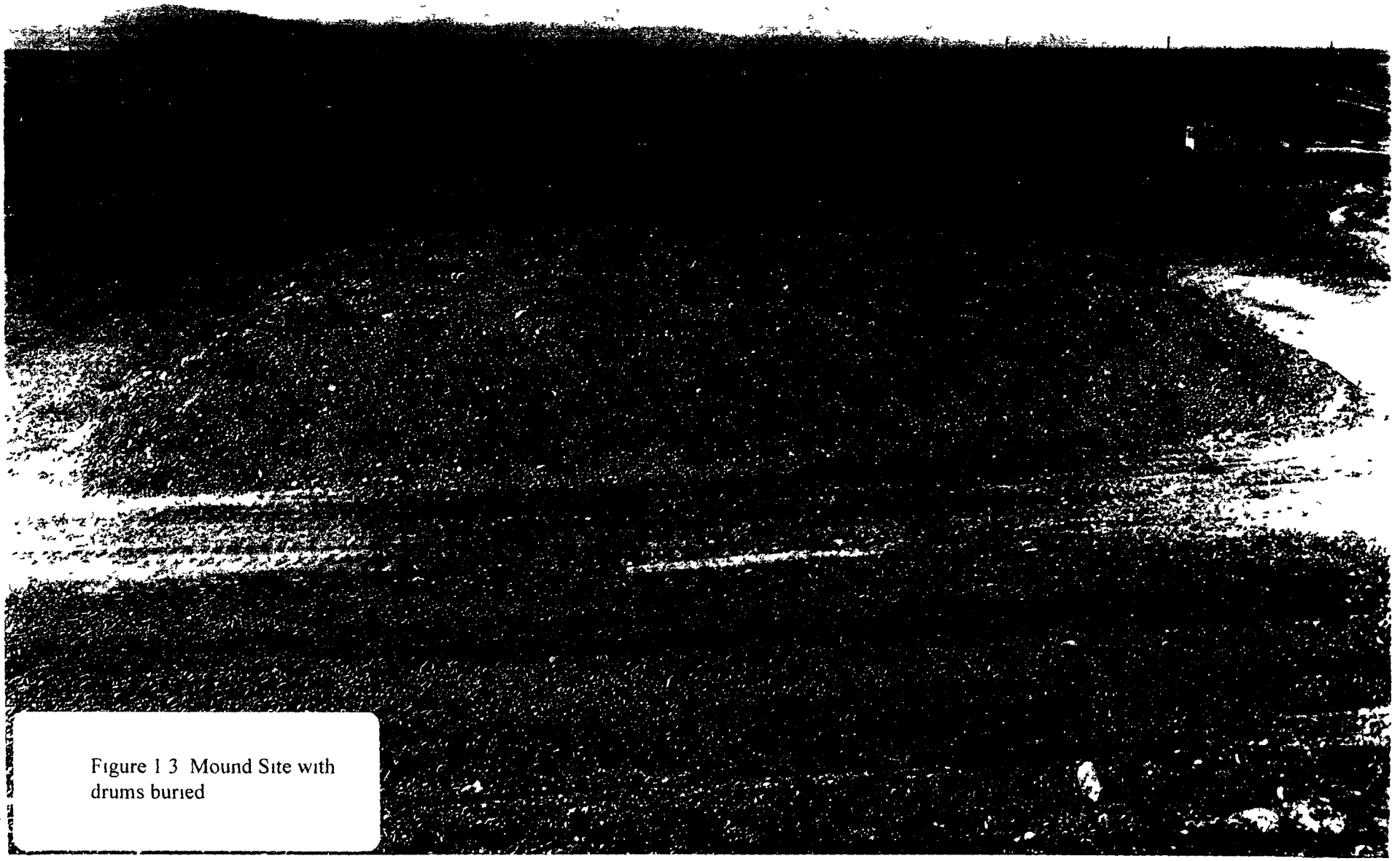


Figure 1 3 Mound Site with drums buried

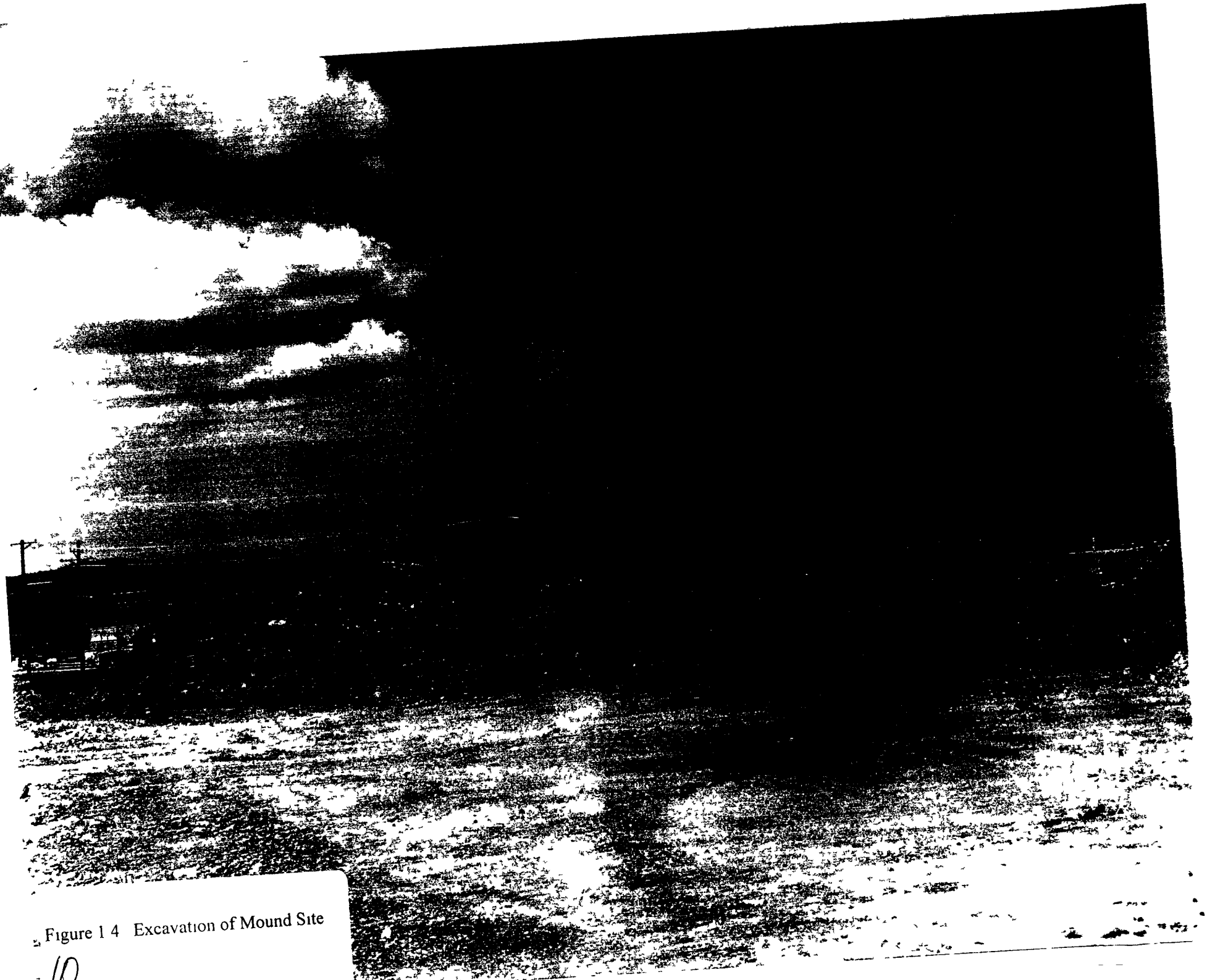


Figure 1 4 Excavation of Mound Site

3.0 SITE GEOLOGY, HYDROGEOLOGY AND EXTENT OF CONTAMINATION

The Mound Site is located at the northern edge of the pediment where up to 12 feet of Rocky Flats Alluvium overlies fractured claystone in the Arapahoe Formation The topography slopes steeply to the north away from the Mound Site towards the incised drainage of South Walnut Creek The Arapahoe No 1 Sandstone subcrops under the alluvium at the northwest corner of the Mound Site This sandstone is truncated by the South Walnut Creek drainage and subcrops beneath the colluvium between the Mound Site and South Walnut Creek

In the vicinity of the Mound Site, the Rocky Flats Alluvium consists of beds and lenses of poorly to moderately sorted clayey and silty gravels and sands interbedded with clay and silty lenses or beds The hill slope below the contact between the Rocky Flats Alluvium and the underlying Arapahoe Formation is covered with unconsolidated colluvium primarily composed of clay, or silty and/or sandy clay Caliche is common in both alluvium and colluvium Numerous slump features are present on the slope

The unconsolidated materials are generally dry through most of the year Groundwater is mostly found in the No 1 Sandstone at depths of approximately 12 feet Saturated alluvium occurs in bedrock lows and scours in the top of the bedrock The groundwater flow in the unconsolidated material appears to be primarily along the bedrock surface and is probably controlled by small channels incised into the bedrock surface Groundwater flow occurs in the Arapahoe No 1 Sandstone consistent with the local gradients evident on the maps presented in the Hydrogeologic Characterization Report (1995b) The subcrop location of the No 1 Sandstone is inferred from a line of seeps along the south slope of the South Walnut Creek drainage The geometric mean for the hydraulic conductivity of Rocky Flats Alluvium is 6×10^{-4} cm/sec The geometric mean for the Arapahoe No 1 Sandstone hydraulic conductivity is 7×10^{-4} cm/sec The geometric mean for unweathered bedrock is 8×10^{-8} cm/sec Infiltration of precipitation into the underlying unweathered claystone is thus extremely limited (DOE 1995a)

The upper hydrostratigraphic unit (UHSU) is the predominant water-bearing unit of concern at RFETS and is considered to be equivalent to the "uppermost aquifer" as defined by the Resource

Conservation and Recovery Act (RCRA) It consists of unconsolidated, sandy and gravely materials mixed with clay (i e , alluvium, colluvium, and artificial fill), as well as weathered bedrock claystones and sandstones which are hydraulically connected to the alluvium Recharge to the UHSU east of the PA is primarily through localized infiltration of precipitation The Central Avenue Ditch runs along the southern boundary of the Mound Site and probably also recharges the groundwater in the weathered bedrock in this area Discharge from the UHSU occurs primarily through seeps located at the bedrock/alluvium interface where the water bearing units are truncated by the South Walnut Creek (DOE 1995a)

The Mound Site contaminated groundwater plume is poorly defined, but it is suspected to extend northward from the former location of the Mound Site where drums were buried, to a point of discharge along the south bank of South Walnut Creek, upstream of the RFETS Sewage Treatment Plant Depending on the season, there may be many unsaturated areas within the plume The presence of dense nonaqueous phase liquids (DNAPLs) in the Mound Site area is suspected, because groundwater in several nearby wells contains contaminant concentrations that exceed 1% of the solubility limit, indicating that free product may be present The Mound Site is expected to be the source of this groundwater contamination and the potential exists for contaminant concentrations to increase over time (DOE 1995a)

Trench T-1 (IHSS 108) is located immediately south of the Mound Site and contains buried drums containing depleted uranium chips in lathe coolant (Figure 3 1)(DOE 1992) There is a possibility that contaminants from Trench T-1 contributes to the contaminated groundwater plume, however, dry wells between Trench T-1 and the Mound Site suggest that the Mound Site is the primary source of the contaminated groundwater plume Along the west end of Trench T-1, the No 1 Sandstone occurs below the base of the trench and potentially contributes contaminants to the groundwater In addition, undetected flow of contaminated groundwater could be occurring through saturated alluvium in bedrock lows and scours in the top of the bedrock

Thirty-five VOCs were detected in the contaminated groundwater at the Mound Site Elevated concentrations of tetrachloroethene, trichloroethene, cis-1,2-dichloroethene and vinyl chloride are consistently found at this location All other VOCs were sporadically detected or limited in

extent and all were present at concentrations below 100 ug/l Tetrachloroethene was the predominant contaminant with the highest concentration of 13,000 ug/l found directly in the Mound Site The maximum concentration of cis-1,2-dichloroethene (214 ug/l) and trichloroethene (410 ug/l) occurred in the same sample as the maximum tetrachloroethene value Concentrations of these chemicals decrease toward South Walnut Creek The maximum vinyl chloride concentration occurred as 860 ug/l in a well along the South Walnut Creek drainage, indicating that this is likely a degradation product, not a primary constituent (DOE 1995a)

The contaminant plume is discharging through surface and subsurface seeps along the hillside, and along seeps on the south bank of South Walnut Creek At seep SW059, groundwater containing low levels of VOCs with trace amounts of radionuclides discharges at a rate of 0 5 gallons per minute, or less The seep water is collected and treated at the Building 891 Consolidated Water Treatment Facility

4.0 DESCRIPTION OF INVESTIGATION

This investigation was conducted per the Sampling And Analysis Plan (SAP) for the Pre-Remediation Investigation of the Mound, 903 Pad and Trench T-1 (RMRS 1996b) The SAP describes the investigative approach for defining the areal extent of the VOC contamination at the Mound Site (IHSS 113) The Mound Site portion of the investigation was designed to meet the data quality objective (DQO) to define the areal extent of contaminated soils at the Mound Site to sufficiently support planning of remedial activities In addition, the SAP includes the approach to be used for the pre-remedial investigation at Trench T-1 (IHSS 108) and the 903 Pad (IHSS 112) in support of early removal actions These tasks have not yet been completed due to sitewide funding priorities

4 1 Planned Investigation

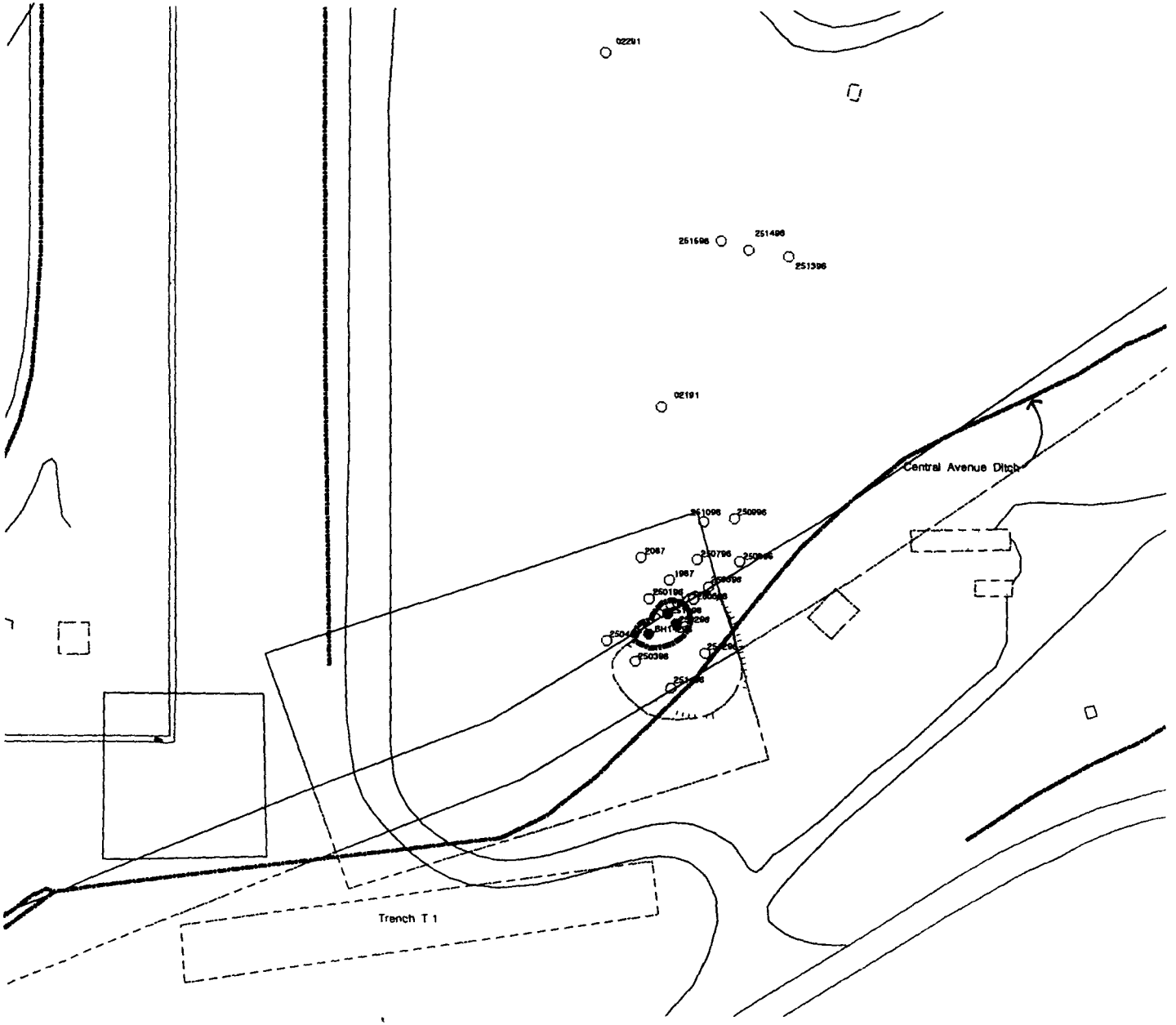
Geoprobe borings were used to collect subsurface soil samples at the Mound Site These soil samples were transported to the Building 881 Laboratory and were analyzed using the same Total Volatile Organic Analysis (VOA) methodology used for the Trench T-3/T-4 Accelerated

Action excavation confirmation samples (RMRS 1996c) The Geoprobe borings were located within the previously documented area of elevated VOCs in soil gas and subsurface soils at the Mound Site (Figure 3 1) This area is centered near borehole 14295 which contained the highest levels of VOCs in subsurface soils found at the Mound Site

Sample locations were to be located on a grid spacing of twenty feet to the north, south, east and west of borehole 14295 Samples were to be collected at five feet intervals below ground surface to a depth of one or two feet below bedrock If total VOCs were detected above ten parts per million (ppm), then the sampling grid was to be extended an additional twenty feet to the north, south, east, and west of that location and additional samples were to be taken If liquid contaminants were encountered, the step out was to be reduced to ten feet This process was expected to continue until the area of contamination in the subsurface soil above ten ppm was defined Of the total samples collected, approximately 10% were to be collected from the areas of the highest total VOC concentrations and analyzed using the VOA CLP methodology to confirm the results of the Total VOA sample results Geoprobe locations were to be modified in the field on the basis of the field results as obtained (i e if areas of high VOC contamination are found, additional Geoprobe locations may be required to further delineate the extent of contamination)

4.2 Investigation as Completed

Thirteen Geoprobe boreholes were completed at the Mound Site and three additional boreholes were completed downgradient of the Mound Site in an attempt to intercept the contaminated groundwater plume derived from the source material at the Mound Site Four initial boreholes were laid out approximately 20 feet north, south, east and west of the highest known subsurface contamination, which was found in Borehole 14295 Locations 250196 and 250396 were placed less than 20 feet from 14295 due to steep slopes on the side of the Central Avenue Ditch at the planned locations The remaining boreholes were located 20 feet from 14295 using tape and compass methods (Figure 3 1)



Mound Area Geoprobe Investigation

94 PCE in soil gas @5 ft
96 PCE in Soil Gas
'94 PCE in Soil Gas @10 ft
wells & borings
Buildings
IHSS
Surface hydro
Unpaved
Impervious

Filled circles indicate soil contamination

N

Figure 3 1

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All of the original locations required multiple offsets due to the presence of an extensive gravel-clay lens at approximately six to eight feet None of these Geoprobe holes reached weathered bedrock Boreholes to the south, west and north of 14295 did not detect elevated levels of VOCs Samples to the east of 14295 (250296) encountered high levels of PCE at depths between four and six feet below ground surface Six additional boreholes (250596 through 251096) were stepped out to the east and north of this location to determine the extent of the subsurface soil contamination and to attempt to penetrate to bedrock These boreholes also required multiple offsets, and none penetrated to weathered bedrock However, no elevated levels of Volatile Organic Compounds (VOCs) were observed in this series of boreholes

Boreholes 251196 and 251296 were drilled southeast of 250296 in the bottom of the Central Avenue Ditch to determine if the observed contamination at the Mound Site was derived from Trench T-1 These boreholes penetrated to weathered bedrock at depths of 12 feet below ground surface without requiring offsets, or encountering detectable levels of VOCs This indicates that Trench T-1 may not be a source of the observed contamination at the Mound Site The depth to bedrock in these boreholes suggests that the bedrock is approximately 15 to 18 feet below ground surface at the contaminated portion of the Mound Site

Geoprobe holes 251396 through 251596 were located 200 feet north of the Mound Site, across the trend line between locations with known contamination 250296, 1987 and 02191 These boreholes were located on the hill slope northeast of the Mound Site, and were expected to intercept a rivulet of contaminated groundwater suspected to be the source of contamination in well 02191 and seep SW059 Geoprobe location 251396 intersected a shallow depression in the bedrock surface which contained approximately three feet of saturated material, indicating that this location was on or near the suspected rivulet However, borehole conditions did not allow collection of a water sample Subsequent boreholes spaced 20 and 40 feet to the west of 251396 exhibited an approximate three foot rise in the bedrock surface No water was observed at any time in these boreholes This suggests that flow from the Mound Site occurs along the bedrock/alluvial-colluvial contact, and is confined to flow in shallow, narrow channels along the bedrock surface

The final borehole (251696) was drilled four feet north and four feet west of 250296, the only borehole with detectable VOCs, to obtain verification samples for relating Total VOA sample results to the VOA (Contract Laboratory Program) CLP values This borehole reached unweathered bedrock at a depth of 13 feet, due to the absence of the gravel-clay lense at this location Samples from this borehole exhibited the highest levels of subsurface soil VOC contamination of the program (up to 140,000 ug/Kg), and the contamination extended to the bedrock surface Table 1 provides the analytical results received, and state plane coordinates for the boreholes

5.0 RESULTS AND INTERPRETATIONS

Of the 16 boreholes drilled, contaminated subsurface soils were detected in only two (Figure 3 1) The only contaminant detected in the Total VOA analyses was tetrachloroethene with a maximum concentration of 140,000 ug/Kg The confirmation soil samples from this same location detected tetrachloroethene at concentrations of 200 ug/Kg to 440,000 ug/Kg Except for the upper value, the confirmation VOA CLP analyses generally agreed with the Total VOA analyses Table 1 also lists the confirmation sample results

The program delineated the VOC contaminant source at the Mound Site sufficiently to plan remedial actions Based on previous soil-gas investigations, analytical data from previous well and borehole locations, and the current program results, there is closure of the source material to the west, east, north and south This area is approximately 30 feet by 30 feet

Assuming that contamination extends uniformly to the unweathered bedrock surface (18 feet below ground surface), the source volume is estimated at 16,200 cubic feet (600 cubic yards) The volume of contaminated soil may be less if contamination does not extend through the gravel-clay lens that prevented deeper Geoprobe sampling in many locations The volume of contaminated subsurface soil may be greater if DNAPL is present within small bedrock channels that extend downgradient from the identified area of subsurface soil contamination Actual soil volume removed will depend on the excavation method used Figure 3 1 shows the approximate areal extent of the presumed contaminant source

Table 1 Analytical Results

		TOTAL VOA AND VOA CLP RESULTS							CONTAMINANTS OF CONCERN						
Northing	Easting	LOCATION	LAB SAMPLE ID	DATE COLLECTED	DATE RECEIVED	DATE ANALYZED	DEPTH INTERVAL	TOTAL DEPTH OF BORING	Vinyl Chloride	Methylene Chloride	Carbon Tetrachloride	Tri chloroethene (TCE)	Tetra chloroethene (PCE)	OTHER COMPOUNDS DETECTED	Comments
							(FT)	(FT)	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	COMPOUND	
749614	2086160	250196	SG21001RM	8/2/96	8/2/96	8/8/96	45-55	110	1200 U	600 U	600 U	600 U	600 U	NA	
749593	2086141	250496	SG21002RM	8/6/96	8/6/96	8/8/96	25 35		1200 U	600 U	600 U	600 U	600 U	NA	
		250496	SG21003RM	8/6/96	8/6/96	8/8/96	70-80	90	1200 U	600 U	600 U	600 U	600 U	NA	
749583	2086154	250396	SG21004RM	8/8/96	8/13/96	8/13/96	10 20		1200 U	600 U	600 U	600 U	250 J	NA	
		250396	SG21005RM	8/12/96	8/13/96	8/13/96	50-60	80	1200 U	600 U	600 U	600 U	600 U	NA	
749602	2086173	250296	SG21006RM	8/12/96	8/13/96	8/13/96	10 20		1200 U	600 U	600 U	600 U	1000	NA	Core Barrel broke off in hole unable to collect samples at deeper interval offsets TDed at shallower depths
		250296	SG21007RM	8/12/96	8/13/96	8/13/96	30 40		1200 U	600 U	600 U	600 U	36,000 E	NA	
		250296	SG21008RM	8/12/96	8/13/96	8/13/96	51 55	55	1200 U	600 U	600 U	600 U	160,000 E	NA	
749615	2086182	250596	SG21009RM	8/16/96	8/16/96	8/19/96	10-20		1200 U	600 U	600 U	600 U	600 U	NA	
		250596	SG21010RM	8/16/96	8/16/96	8/19/96	50 60	60	1200 U	600 U	600 U	600 U	600 U	NA	
749620	2086190	250696	SG21011RM	8/16/96	8/16/96	8/19/96	30 40	40	1200 U	600 U	600 U	600 U	600 U	NA	
749633	2086184	250796	SG21012RM	8/19/96	8/21/96	8/21/96	40 50	50	1200 U	600 U	600 U	600 U	600 U	NA	
749632	2086203	250896	SG21013RM	8/20/96	8/21/96	8/21/96	05 15	40	1200 U	600 U	600 U	600 U	600 U	NA	
749653	2086201	250996	SG21014RM	8/20/96	8/21/96	8/21/96	40 50	50	1200 U	600 U	600 U	600 U	600 U	NA	
749652	2086187	251096	SG21015RM	8/21/96	8/26/96	8/26/96	40 50	55	1200 U	600 U	600 U	600 U	600 U	NA	
749569	2086172	251196	SG21016RM	8/22/96	8/26/96	8/26/96	40 50		1200 U	600 U	600 U	600 U	600 U	NA	
		251196	SG21017RM	8/22/96	8/26/96	8/26/96	90 100	120	1200 U	600 U	600 U	600 U	600 U	NA	
749589	2086188	251296	SG21018RM	8/22/96	8/26/96	8/26/96	40 50		1200 U	600 U	600 U	600 U	600 U	NA	
		251296	SG21019RM	8/22/96	8/26/96	8/26/96	90 100	120	1200 U	600 U	600 U	600 U	600 U	NA	
		251396	SG21020RM	8/26/96	8/26/96	8/29/96	10 20		1200 U	600 U	600 U	600 U	600 U	NA	
749780	2086228	251396	SG21021RM	8/26/96	8/26/96	8/30/96	90 100		1200 U	600 U	600 U	600 U	600 U	NA	
		251396	SG21022RM	8/26/96	8/26/96	8/30/96	140-150	160	1 200 U	600 U	600 U	600 U	600 U	NA	
749784	2086208	251496	SG21023RM	8/26/96	8/26/96	8/29/96	40 50		1 200 U	600 U	600 U	600 U	600 U	NA	
		251496	SG21024RM	8/27/96	8/27/96	8/29/96	100 110	140	1 200 U	600 U	600 U	600 U	600 U	NA	
749788	2086194	251596	SG21025RM	8/28/96	8/30/96	9/9/96	120 140	140	1 200 U	600 U	600 U	600 U	600 U	NA	
		251696	SG21026RM	8/29/96	8/30/96	9/9/96	40 50		1200 U	600 U	600 U	600 U	170 J	NA	
		251696	SG21027RM	8/29/96	8/30/96	9/9/96	50 60		1200 U	600 U	600 U	600 U	600 U	NA	
		251696	SG21028RM	8/29/96	8/30/96	9/9/96	80 90		1200 U	600 U	600 U	600 U	120,000 E	NA	
		251696	SG21029RM	8/29/96	8/30/96	9/10/96	70 80		1200 U	600 U	600 U	600 U	140,000 E	NA	
		251696	SG21030RM	8/30/96	8/30/96	9/9/96	90-100		1200 U	600 U	600 U	600 U	120,000 E	NA	
749606	2086169	251696	BH21001RM	8/29/96	8/30/96	9/17/96	40 50		1200 U	600 U	600 U	600 U	600 U	NA	VOA CLP confirmation
		251696	BH21002RM	8/29/96	8/30/96	9/17/96	50 60		1200 U	600 U	600 U	600 U	200 J	NA	samples
		251696	BH21003RM	8/29/96	8/30/96	9/18/96	70-80		120 000 U	58 000 U	58 000 U	58 000 U	440,000	NA	"
		251696	BH21004RM	8/29/96	8/30/96	9/19/96	80-90		24 000 U	12 000 U	12 000 U	12 000 U	96,000	NA	"
		251696	BH21005RM	8/30/96	8/30/96	9/18/96	90-100		12 000 U	5 800 U	5 800 U	5 800 U	75,000	NA	"
		251696	BH21006RM	8/30/96	8/30/96	9/18/96	110-130	130	1200 U	600 U	600 U	600 U	410 J	NA	"

U = Not detected in sample

E = Concentration exceeded calibration limit

J = Concentration was detected below detection limit

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While bedrock was encountered in only three boreholes, the contaminated material was known to have come from buried drums placed above the level of the present ground surface The lack of contamination detected in the near-surficial materials indicates that these areas were away from the original source area, and contamination at depth would probably be related to contaminated groundwater The pattern of contaminated groundwater in wells 1987, 2087, 02191, and 02291 support the assumption that contaminated groundwater, and potentially small quantities of DNAPLs are being transported to the north Well 02291 may be located within a small closed bedrock depression which may trap DNAPLs, accounting for the higher levels of groundwater contamination observed at this location than at upgradient and downgradient locations

Tetrachloroethene concentrations in the groundwater at well 02291 exceed 1% of the solubility limit, indicating that free product may be present Concentrations at well 02191 (between 02291 and 1987) are lower, and this well is frequently dry, possibly indicating that this well is near or on a bedrock high

Geoprobe borings on the slope did not intercept sufficient groundwater to recover samples for analysis On the basis of this and previous investigations, the groundwater is believed to flow in a northerly direction down slope toward the seep at SW059 Geoprobe investigations downgradient from the Mound Area suggest that groundwater in the alluvial and colluvial deposits flows over the unweathered bedrock surface within shallow, narrow erosional channels

6.0 QUALITY ASSURANCE

The original DQO to define the areal extent of contaminated soils at the Mound Site to sufficiently support planning of remedial activities has been met Confirmation samples were collected per the SAP, and confirm the results obtained using the Total VOA methodology Table 2 compares the Total VOA results with the confirmation sample results

Table 2 Total VOA Results and VOA CLP Confirmation Results Comparison

Location	Depth Interval	Total VOA analysis results Tetrachloroethene (PCE)		VOA CLP analysis results Tetrachloroethene (PCE)	
	(feet)	(ug/kg)		(ug/kg)	
251696	40 - 50	170	J	600	U
251696	50 - 60	600	U	200	J
251696	70 - 80	140,000	E	440,000	
251696	80 - 90	120,000	E	96,000	
251696	90 - 100	120,000	E	75,000	
251696	110 - 130	na	U	410	J

U - Not detected in sample
E - Concentration exceeded calibration limit
J - Concentration was detected below detection limit

7.0 RECOMMENDATIONS FOR ADDITIONAL WORK

While this investigation adequately delineated the source area, the associated contaminated groundwater plume is not as well understood The groundwater flow paths seem to be controlled by features on the bedrock surface, and additional investigation will be required prior to capture and/or treatment of the groundwater contaminant plume

Equipment, supplies or drilling techniques should be identified that will allow the Geoprobe to penetrate deeper into the alluvial material at RFETS

8.0 REFERENCES

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